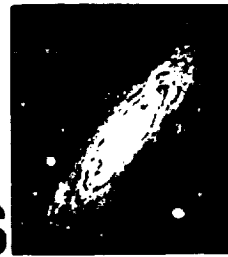


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National Space Science Data Center/
World Data Center A For Rockets and Satellites

THE HEAO A-1 X-RAY SOURCE CATALOG

(Wood *et al.* 1984)

ORIGINAL CONTENT
COLOR ILLUSTRATIONS

Documentation for the Machine-Readable Version

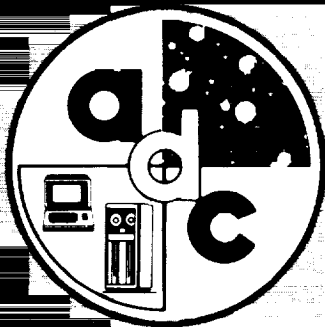
(NASA-TM-105051) THE HEAO A-1 X RAY SOURCE
CATALOG (WOOD ET AL. 1984): DOCUMENTATION
FOR THE MACHINE-READABLE VERSION (NASA)
16 p

CSCL 038

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Unclass

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July 1990

ORIGINAL CONTAINS
COLOR ILLUSTRATIONS

THE HEAO A-1 X-RAY SOURCE CATALOG

(Wood *et al.* 1984)

Documentation for the Machine-Readable Version

Wayne H. Warren Jr.

July 1990

National Space Science Data Center (NSSDC)/
World Data Center A for Rockets and Satellites (WDC-A-R&S)
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Abstract

The machine-readable version of the catalog, as it is currently being distributed from the Astronomical Data Center, is described. The catalog is a compilation of data for 842 sources detected with the U. S. Naval Research Laboratory Large Area Sky Survey Experiment flown aboard the *HEAO 1* satellite. The data include source identifications, positions, error boxes, mean X-ray intensities, and cross identifications to other source designations.

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Abstract iii

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1.0 Introduction

1.1 Description

The primary objective of the Naval Research Laboratory (NRL) Large Area Sky Survey Experiment (LASS) flown aboard the *HEAO 1* satellite was to conduct an all-sky survey for the brightest X-ray sources in the energy range 0.25 to 25 keV. The instrumentation consisted of an array of large proportional counter modules with collimators of varying fields of view and with sufficient sensitivity to detect sources as faint as $0.25 \mu\text{Jy}$ at 5 keV, assuming a Crab-like spectrum ($1.1 \mu\text{Jy}$ at 5 keV = 1 UFU for a Crab-like spectrum). Full sky coverage was achieved in the first 6 months of the mission by continuously scanning great circles perpendicular to the Earth-Sun line. The *HEAO A-1* catalog results from the 6-month survey and, thus, covers the whole sky.

This document describes the machine-readable version of *The HEAO A-1 X-Ray Source Catalog* as it is currently being distributed from the Astronomical Data Center (ADC). It is intended to enable users to read and process the computerized catalog without problems and guesswork. For additional information concerning the NRL LASS instrument, the data analysis procedures, characteristics and limitations of the source data, and a discussion of X-ray source classes, the source publication should be consulted. A copy of this document should be transmitted to any recipient of the machine-readable catalog originating from the international network of astronomical data centers.

1.2 Source Reference

Wood, K. S., Meekins, J. F., Yentis, D. J., Smathers, H. W., McNutt, D. P., Bleach, R. D., Byram, E. T., Chubb, T. A., Friedman, H., and Meidav, M. 1984, "The *HEAO A-1* X-Ray Source Catalog," *Astrophys. J. Suppl.* **56**, 507-649.

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2.0 Structure

2.1 File Summary

The machine version of *The HEAO A-1 X-Ray Source Catalog* consists of a single file. Table 1 gives the machine-independent file attributes. All logical records are of fixed length, and, if the catalog is received on magnetic tape, it will contain blocks of fixed length (as noted below), except that the last block may be short.

<i>The HEAO A-1 X-Ray Source Catalog</i> (Wood <i>et al.</i> 1984)				
File	Contents	Record Format	Logical Record Length	Total Number of Logical Records
1	Catalog	FB	303	842

Table 1. Summary Description of Catalog Files: FB = Fixed length blocks (last may be short)

The information contained in the above table is sufficient for a user to describe the indigenous characteristics of the machine-readable version of *The HEAO A-1 X-Ray Source Catalog* to a computer. Information easily varied from installation to installation, such as block size (physical record length), blocking factor (number of logical records per physical record), total number of blocks, density, number of tracks, and character coding (ASCII, EBCDIC) for tapes is not included, but should always accompany secondary copies if any are supplied to other users or installations.

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2.2 Catalog (File 1 of 1)

Table 2 gives a byte-by-byte description of the contents of the data file. A suggested Fortran format specification for reading each data field is included and can be modified depending upon individual programming and processing requirements (Fortran 77 character string-type formats are used); however, caution is advised when substituting format specifications, since certain fields contain character data. Default (null) values are always blanks in data fields for which primary suggested formats are given as A. Where no default values are given for numerical fields, there are always valid data present. Each data field in the catalog is separated by a blank byte; for brevity, these are omitted from the table.

Byte(s)	Units	Suggested Format	Default Value	Data
1-10	---	A10	---	Source designation (1H)
12-17	°	F6.2	---	Right ascension, α
19-20	hours	I2	---	α
22-23	min	I2	---	α
25-26	sec	I2	---	α
28-33	°	F6.2	---	Declination, δ
35-37	°	I3	---	δ
39-40	'	I2	---	δ
42-43	"	I2	---	δ
45-50	°	F6.2	---	Galactic longitude, ℓ^{II}
52-57	°	F6.2	---	Galactic latitude, b^{II}
59-64	°	F6.2	---	Ecliptic longitude, λ
66-71	°	F6.2	---	Ecliptic latitude, ϕ
73-78	°	F6.2	---	α_1
80-85	°	F6.2	---	δ_1
87-92	°	F6.2	---	α_2
94-99	°	F6.2	---	δ_2
101-106	°	F6.2	---	α_3
108-113	°	F6.2	---	δ_3
115-120	°	F6.2	---	α_4
122-127	°	F6.2	---	δ_4
129-133	□	F5.3	---	Area
135-141	$\text{c cm}^{-2} \text{ s}^{-1}$	F7.4	---	Flux
143-148	$\text{c cm}^{-2} \text{ s}^{-1}$	F6.4	---	Flux error
150-161	---	A12	---	Alternate designation (X-ray)
163-174	---	A12	---	Alternate designation (X-ray)
176-187	---	A12	---	Alternate designation (X-ray)
189-200	---	A12	---	Alternate designation (X-ray)
202-213	---	A12	---	Alternate designation (X-ray)
215-226	---	A12	---	Alternate designation (X-ray)
228-239	---	A12	---	Alternate designation (X-ray)
241-255	---	A15	---	Alternate designation (non-X-ray)
257-271	---	A15	---	Alternate designation (non-X-ray)
273-287	---	A15	---	Alternate designation (non-X-ray)
289-303	---	A15	---	Alternate designation (non-X-ray)

Table 2. Catalog Record Format

Source designation

The 1H catalog designation is composed of the prefix "1H", followed by the right ascension in hours and minutes and the declination in degrees and tenths of a degree (equinox B1950.0).

Equatorial coordinates

The source coordinates (center of error box) are given in degrees and in sexigesimal form. The subscripted right ascensions and declinations (α_{1-4} , δ_{1-4}) give the positions of the 95 percent confidence error box surrounding each source. All positions are for equinox B1950.0.

Area	The solid angle enclosed by the error box. Units are square degrees.
Flux, Error	The apparent intensity of the source in counts $\text{cm}^{-2} \text{s}^{-1}$ for 0.5 - 25 keV. The determination of the errors is described in Section III of the source reference (Wood <i>et al.</i> 1984). As explained in that paper, an intensity of 10^{-3} counts $\text{cm}^{-2} \text{s}^{-1}$, which is the limiting flux in the catalog, corresponds to 3.3×10^{-12} ergs $\text{cm}^{-2} \text{s}^{-1}$ in 2-10 keV, both for a Crab-like spectrum, meaning that 10^{-3} counts $\text{cm}^{-2} \text{s}^{-1}$ in <i>HEAO</i> A-1 is equivalent to 0.20 UFU or to 0.22 μJy at 5.2 keV, again for a Crab-like spectrum.
Alternate identifications	<p>The first seven fields (bytes 150-239) contain alternate designations of each source in other X-ray catalogs, while the last four fields are for non-X-ray cross identifications. Catalog identifications and references are given in Table 5 of the source paper. Cross identifications were selected according to certain criteria. For X-ray catalogs (4U, 2A, 1M, etc.), where error boxes of up to several degrees are sometimes reported, the cross reference is given whenever the other error box intersects the <i>HEAO</i> A-1 error box. Identifiers are also given in certain cases where boxes do not strictly intersect but are sufficiently close to suggest a possible relationship. The criterion used is that the separation between box centers must be less than the sum of the two largest dimensions. The designation "XRS" (not included in Table 5, but described in text) is from Amnuel, Guseinov, and Rakhamimov (1979), which summarizes much of the older X-ray literature.</p> <p>Non-X-ray cross identifications were made on several bases. Whenever an identification has been firmly established, for example, by a precise position from a modulation collimator or from the <i>Einstein Observatory</i>, it is always shown, but so are many additional tentative identifications. Some of these have been suggested by earlier work (in which case the earlier literature appears either in Table 5 or Table 6 of the source reference) and the remainder have been found by searching the non-X-ray catalogs listed by the authors in their Table 5. Additional information on selection criteria will be found on page 647 of the source reference.</p> <p>Whenever an "(R)" appears in the last field, additional references and comments will be found in Table 6 of the source reference. Those entries are intended primarily to provide a sketch of the basic background and current state of knowledge concerning the sources, to direct users to further literature, and to clarify ambiguities. They are not intended to be a comprehensive bibliography and many references are omitted. A special effort has been made to provide cross references to other <i>HEAO</i> / literature wherever possible, since other <i>HEAO</i> / observations are simultaneous with and complementary to those in the catalog.</p>

3.0 History

3.1 Remarks and Modifications

The HEAO A-1 X-Ray Source Catalog was received on magnetic tape by the National Space Science Data Center on 20 July 1984 from Dr. Kent S. Wood of the Naval Research Laboratory. The tape was in VAX VMS BACKUP format with variable length logical and physical records, plus special control words (logical record length of each record in the first four bytes.) A program was written to convert the records to fixed length and the tape file was processed to disk storage on the IBM 3081 computer of the NASA Space and Earth Sciences Computing Center at GSFC. The format of the file was identical to Table 4 of the published catalog, meaning that there were 10 sources per group (page in the published catalog), separated by column headings and blank records, etc. All blank, text, and separator records were removed with an editor, leaving just four records per source. A format was designed that rearranged the data in logical order for a single record per source structure, and a program was written and executed to reformat the data. The advantages of the single record per source structure are that all records are entirely uniform and the catalog can be sorted and searched easily.

The original catalog contained the error box positions in both decimal and sexigesimal form. The latter data were omitted during the conversion in order to decrease the final record length, since the sexigesimal data can be reconstructed easily from the decimal positions given.

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4.0 Acknowledgments and References

4.1 Acknowledgments

Appreciation is expressed to Kent Wood for communicating about the catalog in 1986 and for supplying multiple copies of the source paper along with a color reprint of Figure 14 of the paper, which was originally published in black and white. The color print is reproduced at the end of this section. It is a display, in galactic coordinates, of all sources given in the catalog. The dot size represents source intensity, with dot radius proportional to the logarithm of the intensity reported in the catalog. I also thank Dr. Wood for reviewing and commenting on a draft version of this document.

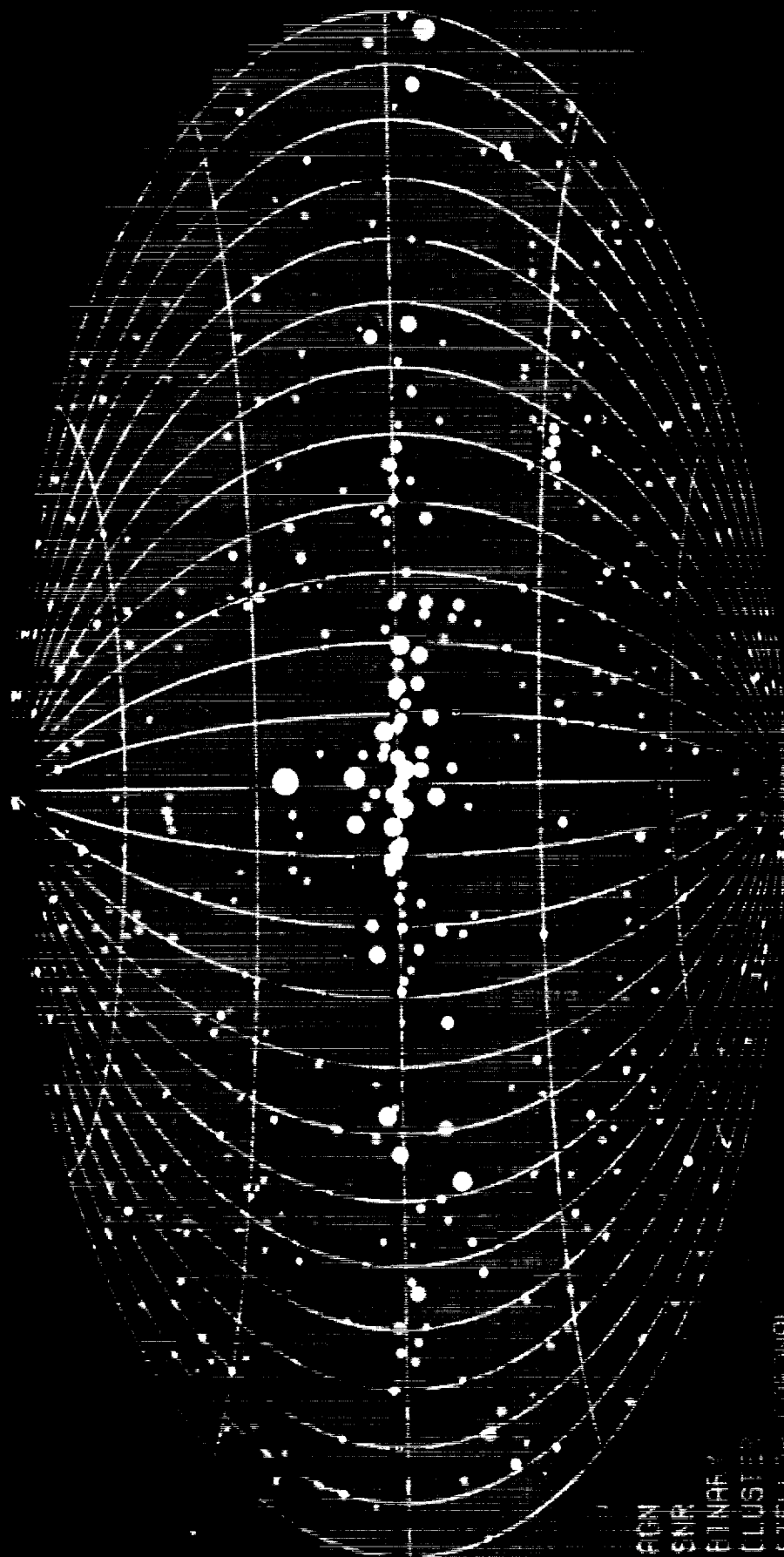
The help of Jonathan McDowell of the Harvard-Smithsonian Center for Astrophysics is also gratefully acknowledged. Dr. McDowell requested a machine-readable copy of the catalog and made suggestions about the proposed format, including the elimination of the redundant error box positions in sexigesimal form.

4.2 References

Amnuel, P. R., Guseinov, O. H., and Rakhamimov, Sh. Yu. 1979, *Astrophys. J. Suppl.* **41**, 327.

Wood, K. S., Meekins, J. F., Yentis, D. J., Smathers, H. W., McNutt, D. P., Bleach, R. D., Byram, E. T., Chubb, T. A., Friedman, H., and Meidav, M. 1984, "The HEAO A-1 X-Ray Source Catalog," *Astrophys. J. Suppl.* **56**, 507-649.

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1. **CON**
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 3. **BINRA**
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 6. **CONJUGAL**
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5.0 Sample Listing

The sample listing given on the following pages shows logical records exactly as they are recorded in the machine-readable version of the catalog. Groups of records from the beginning and end of the file are illustrated. The beginning of each record and the bytes within the record are indicated by the column heading index across the top of each page (digits read vertically).

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HOT NEWS

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Securities 1 to 20

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Library Location

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2	1000000-751	1.91	00	00	07	75.17	75	10	11	119.07	10.01	60.96	399.79	72.59	5.75	79.02	6.22	75.05	.39	72.50	329	.0004	.0007	00	0000-75	0000000-756	(03)	
3	1000000-900	2.21	00	00	08	90.00	90	00	00	000.00	-02.05	90.00	-02.05	-02.09	.11	-75.20	5.20	-75.76	1.06	-75.43	479	.0004	.0010				(03)	
4	1000000-915	2.62	00	10	10	91.51	91	05	317.15	91.40	100.00	-04.06	1.00	-02.00	1.00	-02.00	1.00	-02.00	1.00	-02.00	1.00	.0006	.0007				(03)	
5	1000011-209	2.90	00	11	10	209.00	209	00	00	000.00	-02.05	90.00	000.00	-02.09	1.00	-02.00	1.00	-02.00	1.00	-02.00	1.00	.0004	.0009				(03)	
6	1000014-040	5.79	00	14	04	-04.04	-04	10	10	100.00	-02.05	90.00	000.00	-02.09	1.00	-02.00	1.00	-02.00	1.00	-02.00	1.00	.0004	.0009				(03)	
7	1000014-111	5.79	00	14	11	111.00	111	10	10	100.00	-02.05	90.00	000.00	-02.09	1.00	-02.00	1.00	-02.00	1.00	-02.00	1.00	.0004	.0009				(03)	
8	1000015-207	6.16	00	15	20	-20.70	-20	10	10	100.00	-02.05	90.00	000.00	-02.09	1.00	-02.00	1.00	-02.00	1.00	-02.00	1.00	.0004	.0009				(03)	
9	1000017-075	6.57	00	17	00	7.56	07	21	02	100.00	-02.05	90.00	000.00	-02.09	1.00	-02.00	1.00	-02.00	1.00	-02.00	1.00	.0004	.0009				(03)	
10	1000018-200	6.94	00	18	00	20.00	20	00	00	110.70	10.00	10.00	20.00	5.45	27.70	5.45	27.70	5.45	27.70	5.45	27.70	5.45	.0004	.0009				(03)
11	1000018-200	6.94	00	18	00	20.00	20	00	00	110.70	10.00	10.00	20.00	5.45	27.70	5.45	27.70	5.45	27.70	5.45	27.70	5.45	.0004	.0009				(03)
12	1000020-000	8.51	00	20	00	00.00	00	00	00	1.00	02.00	00.00	1.00	02.00	00.00	1.00	02.00	00.00	1.00	02.00	00.00	1.00	.0004	.0009				(03)
13	1000020-206	6.17	00	20	20	-20.41	-20	40	11	0.00	-02.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	.0004	.0009				(03)	
14	1000020-206	6.17	00	20	20	-20.41	-20	40	11	0.00	-02.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	00.00	.0004	.0009				(03)	
15	1000021-107	7.79	00	21	07	-19.79	-19	04	14	95.94	-01.51	399.99	-01.51	6.75	-00.00	6.75	-00.00	6.75	-00.00	6.75	-00.00	6.75	.0004	.0009				(03)
16	1000020-000	9.96	00	20	00	00.00	00	00	00	1.00	02.00	00.00	1.00	02.00	00.00	1.00	02.00	00.00	1.00	02.00	00.00	1.00	.0004	.0009				(03)
17	1000042-000	16.00	00	42	00	-04.00	-00	20	36	117.40	-71.07	5.91	-1															

